Space Weather Technical Forecast

Issued on Thursday, 06 January 2022 at 12:39 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of minor geomagnetic activity day 3 (8th).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low over the past 24 hours, with only B-flares observed. There are two sunspot regions on the visible disc; AR2924 Dso/Beta and AR2925 Dao/Beta, both in the southeast quadrant. However, as AR2925 is still close to the southeast limb confidence is lower regarding its analysis and classification. No Earth-directed CMEs have been observed in the available imagery.

Solar Wind / Geomagnetic Activity: Solar winds as observed at L1 were predominantly slightly elevated, around 400-420km/s, with a peak of 450 km/s at 05/2043 UTC, before declining to slow-ambient levels, at around 350km/s by end of the period. Density has been average. The interplanetary magnetic field strength (IMF Bt) was weak at around 5nT, with a mostly positive Bz value. The Phi angle has also been mainly positive (Away from the Sun). Geomagnetic activity has been Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at background levels. High energy electron flux (greater than 2MeV) has been predominantly at moderate levels, but did very briefly peak at 1009 pfu at 05/1655 UTC. Electron fluence remained below the Active threshold (1e8), with a generally level trend, and 4.1e7 integrated pfu was recorded at 06/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Mostly Very Low solar activity is expected, with a chance of increasing to Low at times (C-class flaring) from either of the sunspots on the disc. New or returning previous regions will potentially rotate onto the visible disc through the period, with a new region or plage area expected to imminently arrive onto the northeast limb. Therefore solar activity may increase, bringing a slightly raised chance of isolated M-flares.

Solar Wind / Geomagnetic Activity: There are currently no Earth-directed CMEs. Solar winds are expected to remain mainly slow and ambient until day 3 (8th) when a CIR and the arrival of a coronal hole fast wind is anticipated. Mainly Quiet geomagnetic conditions are expected until then, increasing to Unsettled to Active (Kp 3-4) from day 3 (8th Jan) with a chance of G1/Minor storm intervals (Kp 5).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at background levels in the absence of solar activity. The High energy electron flux (greater than 2MeV) may temporarily exceed the High (1e3pfu) threshold at the diurnal peaks, mainly today and tomorrow (6th and 7th), but also day 4 (9th). Otherwise the high energy flux will persist at generally moderate levels. The electron fluence is expected to remain below the Active level (1e8 integrated pfu), with a generally steady trend.

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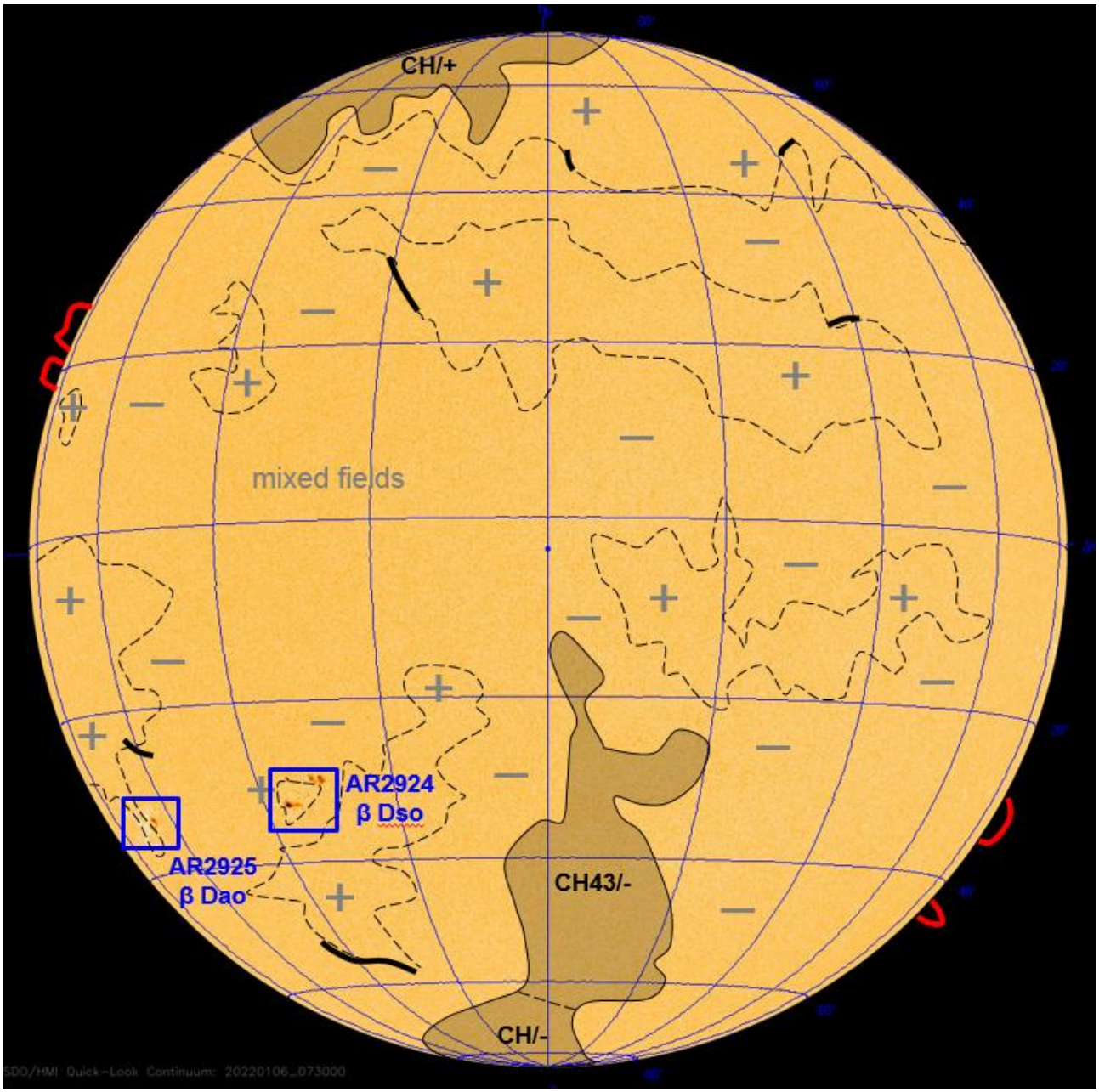
Figure 1. Solar Analysis Valid 06/0730UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There currently no Earth-directed CMEs. Mainly ambient solar winds are expected to continue with no features expected until the CIR and fast wind of CH43 (-ve) arrives through day 3 (8th). This is a new feature on this rotation, with the coronal hole becoming more prominent. Therefore confidence is moderate on timing and strength, with best estimate of elevated solar winds between 500-600km/s, as roughly indicated by STEREO A approximately 3 days ago. A Solar Sector Boundary Crossing (SSBC) may also precede the coronal hole, but currently we are connected to a positive region of the current sheet (Phi Angle is currently positive) and the coronal hole is negative. This may allow for a temporary unsettled period in geomagnetic activity.

Mainly Quiet geomagnetic activity is forecast until day 3 (8th Jan), with Unsettled to Active and a Chance of G1/Minor Storms thereafter.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	5	20	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: SDO/AIA 193 shows coronal hole 43 on current rotation (left), but the coronal hole was absent on previous rotation (right) 27 days ago (10th Dec)

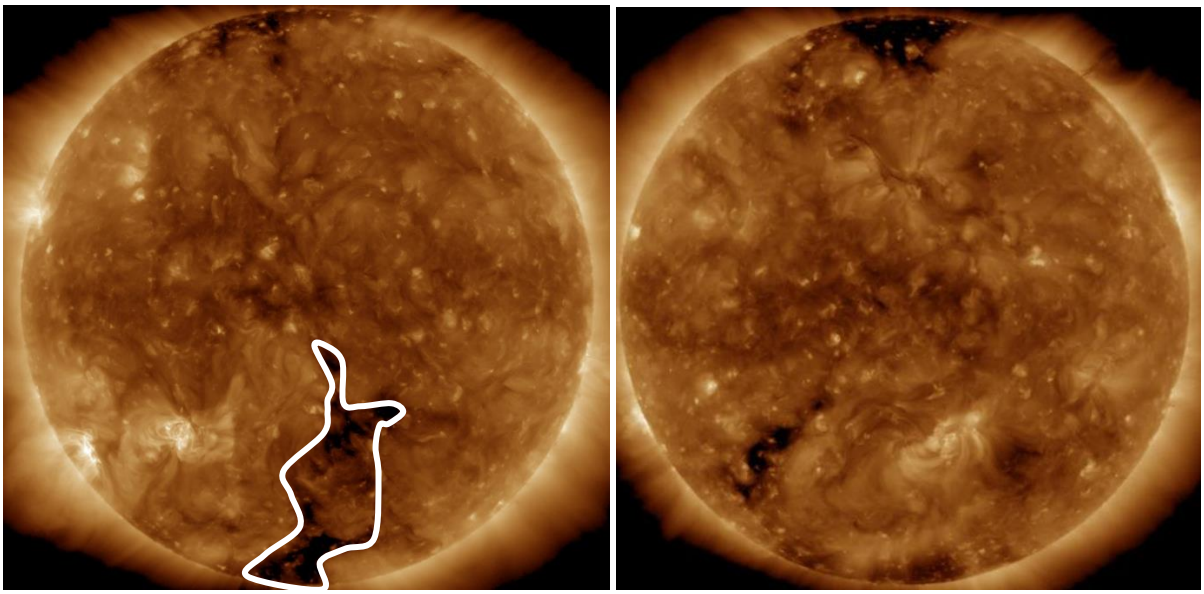

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Figure 3: STEREO-A mag and plastic (2.7 days) showing increase in solar winds between 500-600km/s approximately 3 days ago.

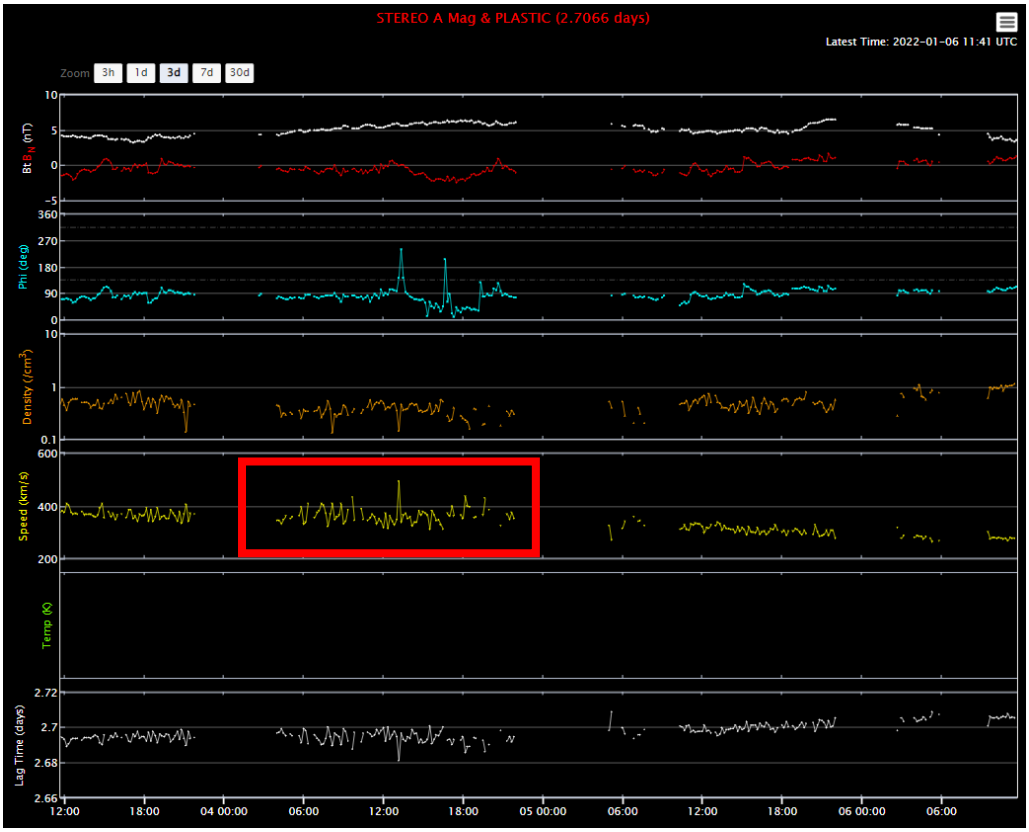
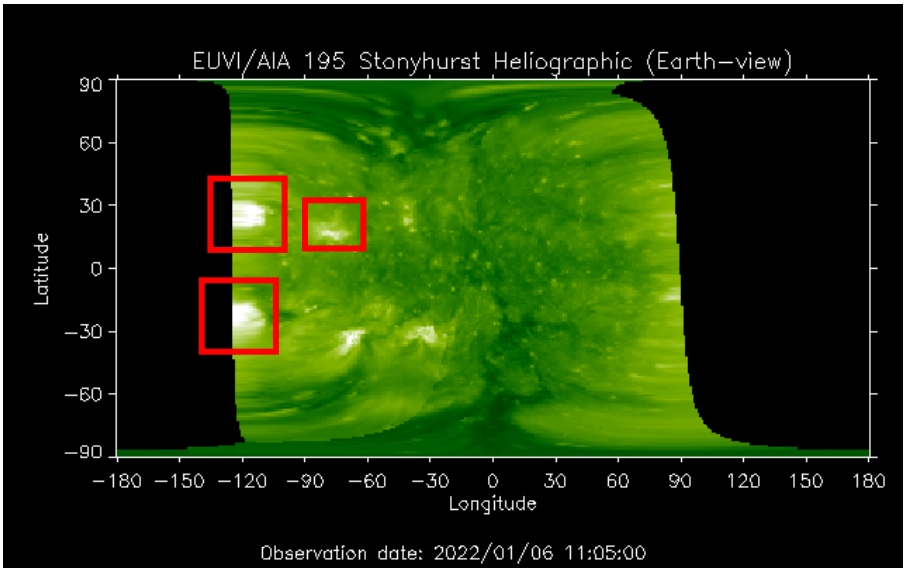

STEREO A Mag & PLASTIC (2.7066 days)
Latest Time: 2022-01-06 11:41 UTC
Zoom 3h 1d 3d 7d 30d
Bt Bx (nT)
Phi (deg)
Density (/cm³)
Speed (km/s)
Temp (K)
Lag Time (days)
12:00 18:00 04 00:00 06:00 12:00 18:00 05 00:00 06:00 12:00 18:00 06 00:00 06:00

Figure 4: STEREO-A EUVI 195 image shows potential regions to rotate onto the visible disc during the forecast period.



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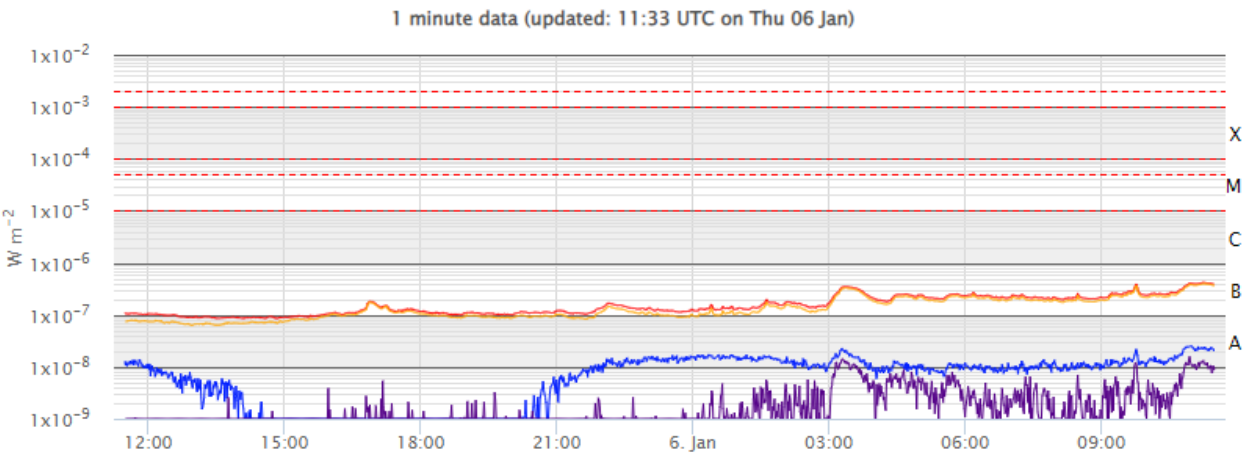
Radio Blackouts - X-Ray Flares:

Solar Activity is currently Very Low. There are two sunspot regions on the visible disc; AR2924 Dso/Beta and AR2925 Dao/Beta, both in the southeast quadrant. However, as AR2925 (currently classified Dao/Beta) is still close to the southeast limb confidence is lower regarding its analysis and classification. AR2925 was potentially ex-2906 on the previous rotation. New or returning previous regions will potentially rotate onto the visible disc throughout the period, with a new region or plage area is expected to imminently arrive onto the northeast limb, plus another new region may rotate around the limb on day 3 (8th). This corresponds to the region of ex-2907 and ex-2908 on the previous rotation, both of which produced M-flares on their previous transit across the Sun.

Generally Very Low activity is expected to persist, but solar activity may increase with the potential arrival of new or returning regions, bringing a slightly raised chance of isolated M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	5	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 5: GOES X-Ray Flux – solar activity is currently Very Low with only minor B-class flares.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently at background levels and will most likely persist at this level in the absence of solar activity.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

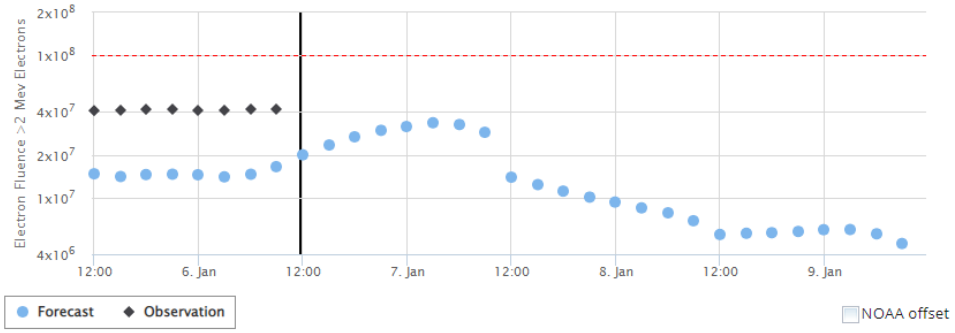
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 is currently at predominately moderate levels, but diurnal peak values are expected to be close to, or temporarily just exceed, the High threshold of 1e3pfu. This is especially likely today, tomorrow and day 4 (9th), while expected slightly enhanced geomagnetic activity suppresses the electron count during day 3.

The electron fluence is expected to remain below the Active level (1e8 integrated pfu). The Met Office REFM model is overall offering good guidance, keeping the fluence below the Active threshold, but a generally steady or even gently rising trend is preferred against the REFM model's decreasing trend.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	10	10	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 6: Met Office REFM model.



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